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Costing Methodology for Next Generation Networks

Executive summary

Legacy, circuit-switched telecommunications networks and the newer, packet-switched networks have traditionally occupied different spaces within organisations, with the former used for voice traffic and the latter for data. While they do share tasks, they perform, for the most part, discrete functions.

But as the telecommunications ecosystem continues to develop rapidly and in particular, shift towards Internet Protocol (IP)-centric solutions for voice and video, there is now a greater need than ever for the deployment of Next Generation Networks (NGNs). NGNs, which are packet-switched and IP-based, are able to support the convergence of previously distinct applications, mirroring the end user experience of converged devices and services. In the meantime, however, as operators begin work on the mammoth task of building the new networks, they will have to contend with maintaining these hybrid networks until the evolution is complete.

As the telecommunications industry continues to advance at breakneck speed, its costing methodologies will need to keep up. Originally designed based on the properties of legacy networks, price regulations for monopolistic services have generally utilised cost models adopting various costing methodologies. The increasing deployment of IP-based fixed and mobile infrastructure in combination with the still unanswered search for data monetisation have intensified the pressure on the industry to review its costing methodologies for both regulatory and commercial cost analyses.

This paper discusses the general concept of costing for telecommunications services, the challenges faced by operators and regulations with the introduction of NGNs, as well as the implications of NGN on traditional costing methods.

The need for a dedicated cost model for NGN

Traditional telecommunications cost models
Traditionally, cost models were tools used by regulators to monitor and control prices for access and interconnection services which are monopolistic in nature. Over time, operators have also developed cost models to analyse their own cost structures for regulatory and business purposes. With developments in new technology, services and regulations, cost models have gradually evolved to reflect these changes. At present, the capabilities of cost models have expanded and can be used for regulatory pricing (tariff regulations), profitability analysis (pricing strategies), regulatory accounting (accounting separation), and cost optimisation, amongst other purposes.

Types of cost models
Telecommunication networks are capital-intensive and involve shared platforms and systems that support multiple services. As a result, numerous cost models exist and the treatment of such costs will need to be defined. The three main models are:

- *Standalone Cost:* This approach is used when the modelled network is providing only a single service and thus all costs (service-specific, joint, and common costs) are allocated to a single service.

- *Fully Allocated Cost (FAC):* All costs are considered and allocated to all services provided by the network; this approach is commonly used in conjunction with a top-down model. Resulting costs for services will be the highest possible and provide an indication of the cost ceiling.

- *Long Run Incremental Cost (LRIC):* With the LRIC, only incremental costs and/or service-specific fixed costs are allocated to services. If joint and common costs are allocated through mark-ups, the LRIC method will begin to resemble FAC. Resulting costs for services will be minimal and provide an indication of the cost floor.

Between the FAC and LRIC models, there are variations of LRIC, mostly relating to differences in the inclusion or exclusion of certains costs and treatment of common costs, with their specific uses dictated by circumstances. A summary of the different methodologies and their corresponding inclusion of cost types is illustrated in Figure 1.
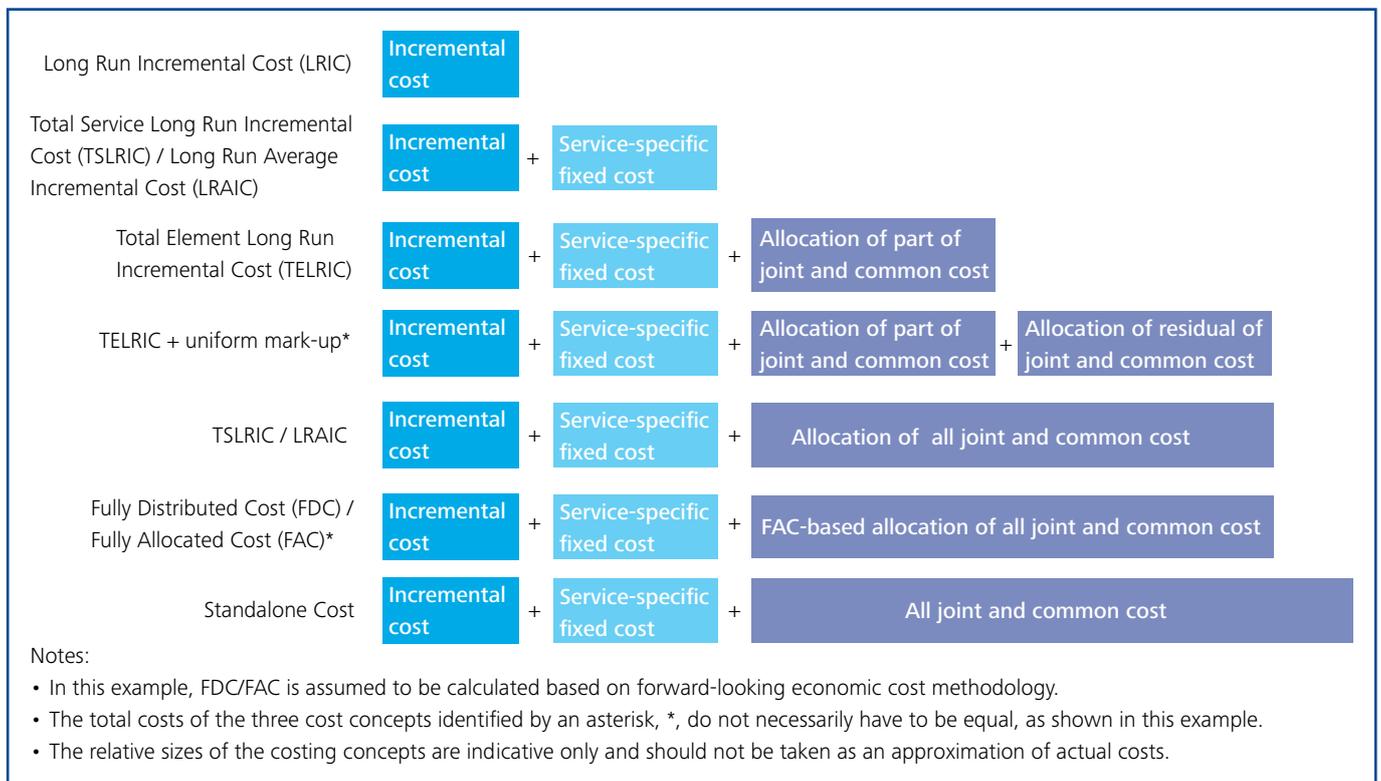

Figure 1: Cost methodologies and corresponding cost types (Source: International Telecommunications Union)

Long Run Incremental Cost (LRIC)	Incremental cost		
Total Service Long Run Incremental Cost (TSLRIC) / Long Run Average Incremental Cost (LRAIC)	Incremental cost	+ Service-specific fixed cost	
Total Element Long Run Incremental Cost (TELRIC)	Incremental cost	+ Service-specific fixed cost	+ Allocation of part of joint and common cost
TELRIC + uniform mark-up*	Incremental cost	+ Service-specific fixed cost	+ Allocation of part of joint and common cost + Allocation of residual of joint and common cost
TSLRIC / LRAIC	Incremental cost	+ Service-specific fixed cost	+ Allocation of all joint and common cost
Fully Distributed Cost (FDC) / Fully Allocated Cost (FAC)*	Incremental cost	+ Service-specific fixed cost	+ FAC-based allocation of all joint and common cost
Standalone Cost	Incremental cost	+ Service-specific fixed cost	+ All joint and common cost

Notes:
- In this example, FDC/FAC is assumed to be calculated based on forward-looking economic cost methodology.
- The total costs of the three cost concepts identified by an asterisk, *, do not necessarily have to be equal, as shown in this example.
- The relative sizes of the costing concepts are indicative only and should not be taken as an approximation of actual costs.

Globally, and especially in the European Union, there has been a marked shift from FAC to LRIC as the costing standard for telecommunication services. Regulators using LRIC cost models to regulate prices for services (e.g. Mobile Termination Rate (MTR), Roaming, Interconnection (IC), Local Loop Unbundling (LLU)) would consider only the incremental or marginal costs incurred by the operators, and thus the prices would be lower relative to the FAC model.

NGN and the key differences from legacy networks

NGN has been defined by the International Telecommunication Union as "a packet-based network able to provide services including Telecommunication Services and able to make use of multiple broadband, quality of service (QoS)-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies[1]." It is an IP-based network with a multi-layer architecture for services, control, transport, and access. Traditional switches are replaced by media gateways and soft switches.

In traditional legacy networks, each service is operated on its own dedicated network – fixed line telephony on public switched telephone networks (PSTNs), mobile voice services on mobile networks, television broadcasting on satellite and cable networks, etc. These networks are designed independently and specifically for a single service.

NGN offers services independent of the type of network because it is a converged multi-service network, as illustrated in Figure 2. These differences will impact current cost modelling methodologies.
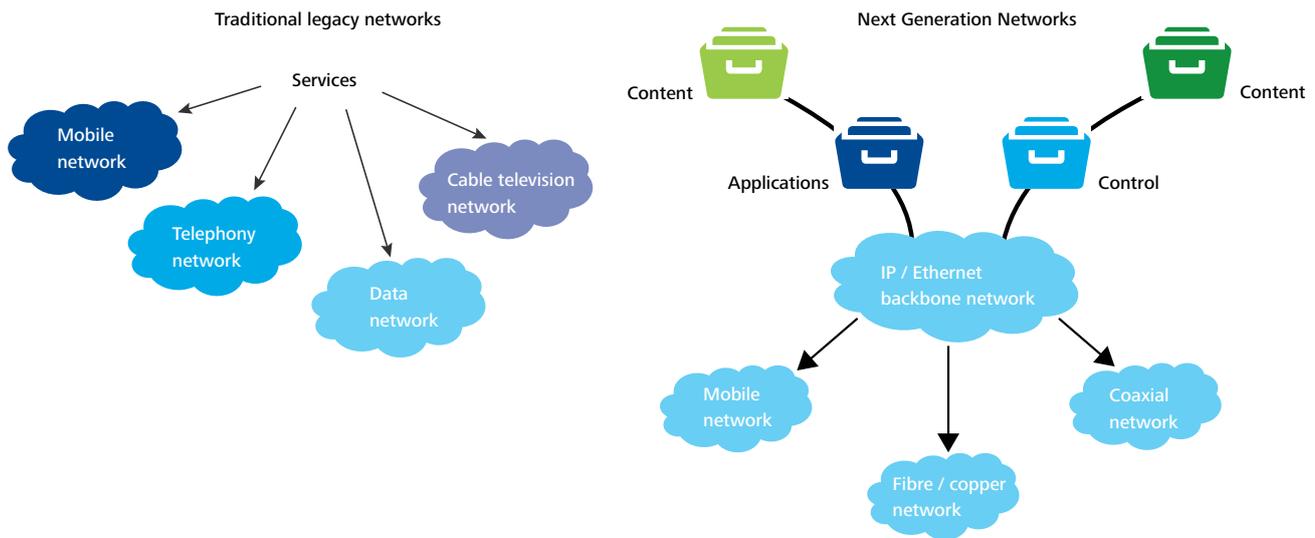

Figure 2: Architectural differences between traditional legacy networks and Next Generation Networks

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[1] NGN Working Definition, International Telecommunication Union (2004)

Creating a successful NGN cost model

Existing costing approaches and methodologies have been designed based on the characteristics of legacy networks and thus are effective when used to model costs of legacy networks. The emergence of NGNs, however, presents a new set of considerations for telecommunications companies as it is much more difficult to apply the traditional cost causality principles. NGNs can have significant impacts on the traditional costing models, including cost allocation, treatment of incremental costs, and regulations based on LRIC.

Network utilisation routing table no longer sufficient for cost allocation

As multi-service platforms, NGN networks would have much higher fixed shared and/or common costs as compared to legacy networks. Consequently, an effective cost allocation method of services is required. In traditional cost models for circuit-switched networks, cost allocation to services was commonly performed through a network utilisation routing table. Network routing scenarios were defined for each particular service using the principle of cost causality and costs have been allocated via degree of utilisation of network elements to their corresponding services.

An NGN network, as an integrated packet-switched network, is capable of handling a wide range of traffic types, each with its own service quality requirements. Service quality is a more complex concept in a packet-switched network and involves a number of criteria such as bandwidth, delay, jitter, packet loss, and blocking probabilities. Consequently, network utilisation routing tables are no longer sufficient to determine the amount of capacity required to meet a given service quality standard. To do this, bandwidth pattern information of services on an NGN network would be required.

A new approach

For an NGN network, a new approach is required to quantify the relationship between traffic volumes, service quality, and capacity to determine the costs that are causally attributable to the various services in a multi-service, packet-based environment[2].

For IP-based services on packet-switched networks, a QoS routing algorithm, that is, one that allocates costs by QoS to services, is preferable as QoS is correlated with bandwidth requirements. The bandwidth usage in one-hour intervals (preferably within at least a 12-hour timeframe) for each modelled service is required.

A sample of the hourly bandwidth utilisation is given in Figure 3. Based on this value, the cost of each modelled service will be distributed based on the weighting of the bandwidth demand by each service, as illustrated in Figure 4.

[2] Davies, Hardt, Kelly – Network Dimensioning, Service Costing and Pricing in a Packet Switched Environment
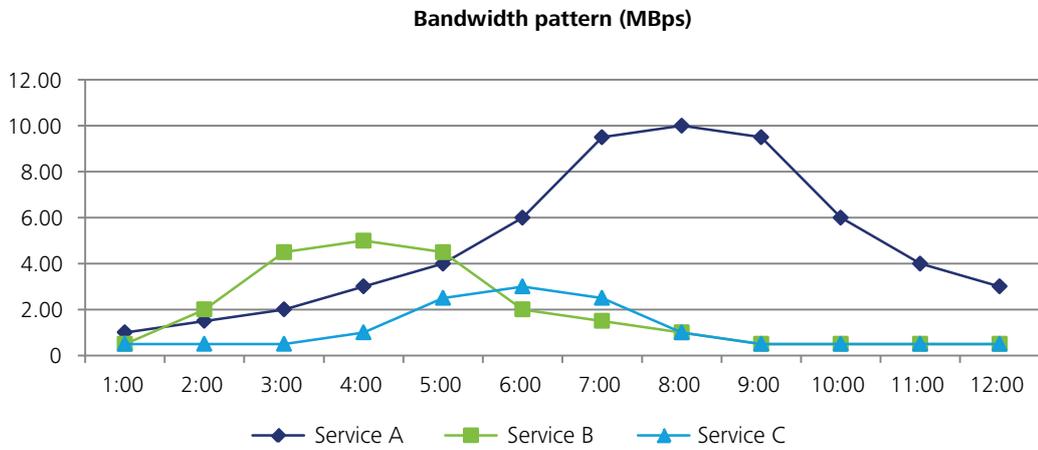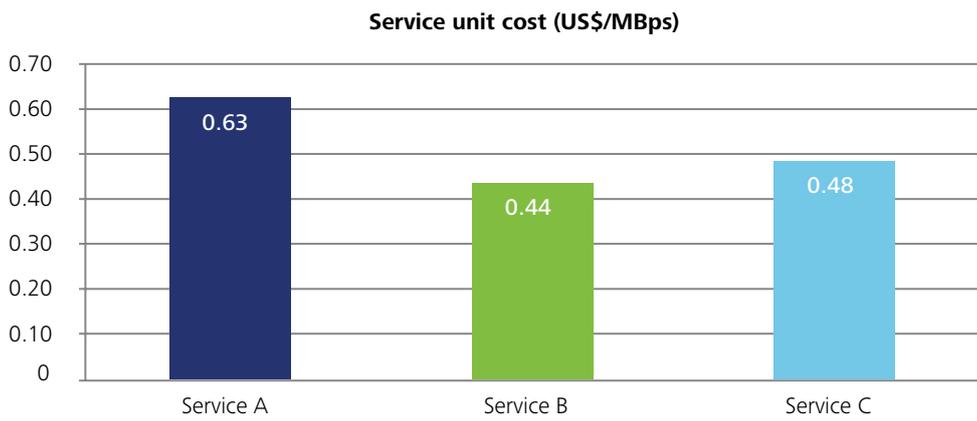
Bandwidth pattern (MBps)

Figure 3: Hourly bandwidth utilisation pattern for sample services

Service unit cost (US$/MBps)

Service	Cost share (%)	Total cost of service (US$)	Peak bandwidth (MBps)	Service unit cost (US$/MBps)
Service A	14.70	1.45	3.00	0.48
Service B	22.05	2.18	5.00	0.44
Service C	63.26	6.26	10.00	0.63

Figure 4: Sample results from a cost allocation by QoS exercise

Treatment of legacy costs during migration to NGN

As NGN network deployment involves new investments with no historical accounts, valuation of assets will follow a current cost accounting (CCA) approach, usually with the use of the Modern Equivalent Asset (MEA) method. The MEA method is the standard approach to asset valuation in a situation where there has been a change in technology (resulting in significant improvements in productive efficiency, functionality or operating cost reductions, for example) and the asset in use cannot be purchased in the form currently utilised by the operator.

If existing assets cannot be replaced in an identical form, the replacement costs of a particular item can be based on the cost of a modern equivalent asset. By using the MEA method, the new investments would be valuated according to their actual purchase price or current cost.

Dealing with "cost hump"

During actual NGN deployment, operators will experience a phase where they are building new networks whilst maintaining existing ones until the evolution completes. This hybrid period could also imply a "cost hump" for operators.

Using MEA to valuate the legacy network would ignore a majority of the costs and thus past investments would not be recovered. If regulators base price regulations on such methods and operators are not allowed to recover historic investments, incentives to invest in new infrastructure would be reduced.

The use of MEA with NGN costing must be done with great care, and other alternative asset valuation methods such as indexation, absolute valuation, and appraisals may be considered. Striking the right balance between costing historical and future investments is essential, and this should be done in consideration of the operators' business and the regulator's objectives.

Regulating prices based on LRIC

LRIC is typically used to regulate the prices of wholesale (interconnection and access) voice services. The incremental or marginal cost of increasing voice volumes is used to set interconnection and access rates. NGN networks have extremely large capacities of network elements as compared to traditional legacy networks. As a result, the incremental or marginal cost for traffic in an NGN network can be close to zero. This is illustrated in Figure 5.

A solution to overcome the differences in incremental cost between the two types of networks is to define precisely the increments in LRIC. For NGN networks, the increment has to be larger to reflect the large additional capacities of the network. With a larger increment, the pricing of services based on incremental cost can again be established.
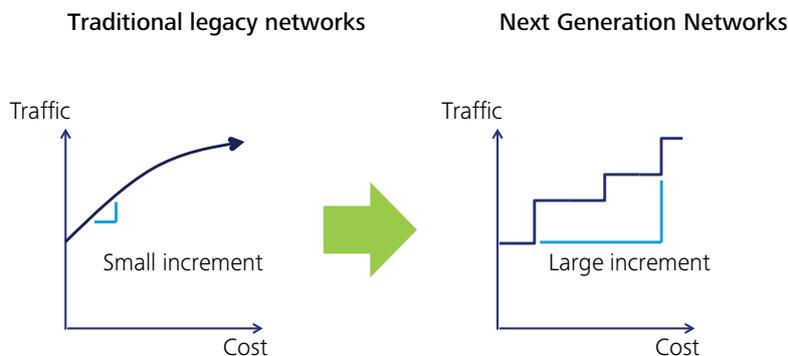
Traditional legacy networks   **Next Generation Networks**

Figure 5: Differences in LRIC for traditional legacy networks and Next Generation Networks

Conclusion

With increasing deployment of NGNs leading to the coexistence with – and, eventually, the replacement of – legacy networks, the impacts of NGNs can no longer be overlooked. Price regulations have generally utilised cost models based on methodologies designed on the properties of legacy networks. The development of NGNs means that these traditional cost models will need to be reconsidered in light of its differences with legacy networks. Three main areas are impacted and this is evident in the application of traditional cost methodologies to NGN: cost allocation; treatment of costs; and regulations based on LRIC.

Cost allocation for NGN and IP-based networks should reflect the relationship between traffic volumes, service quality, and capacity. An allocation key using QoS and bandwidth requirements is recommended instead of the traditional network utilisation routing table.

In the process of migrating to NGN, the cost of migration and treatment of costs of legacy networks would contribute to a significant portion of the overall service costs of operators. Exclusion of such costs would mean that operators are not allowed to recover historic investments and thus incentives to invest in new infrastructure would be reduced. Striking the right balance between costing historical and future investments is essential, and this should be done in consideration of the operators' business and the regulator's objectives.

An NGN network element has extremely high capacities as compared to legacy network elements. Regulating prices based on LRIC and small increments would imply near zero rates for services on NGN networks. The definition for increments would have to be redefined to reflect the actuality of network capacities in NGN networks.

Nevertheless, the costing of NGN networks is still in its infancy as legacy networks are gradually replaced by NGN networks around the world. Costing methodologies and regulations must develop hand-in-hand with technological developments, keeping in mind that the objective of cost models is to reflect the reality of networks.
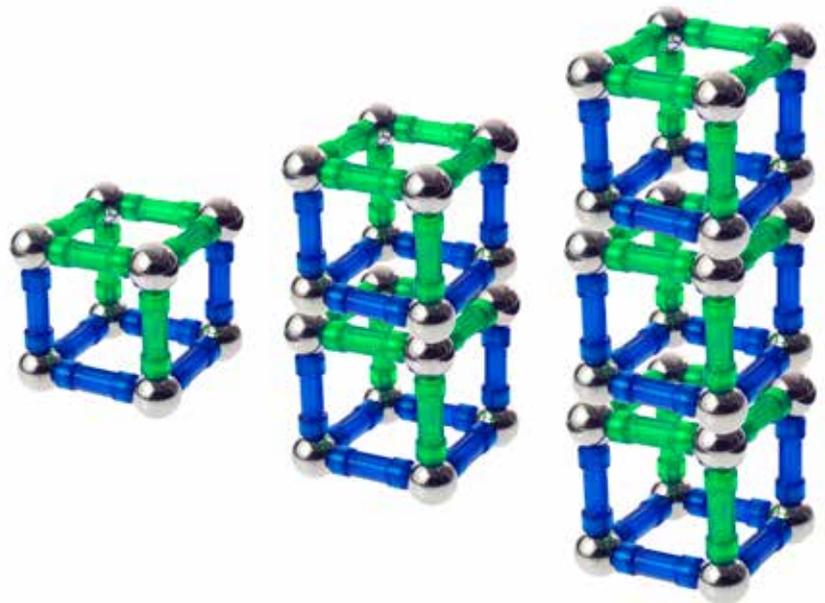
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